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ABSTRACT

It has become necessary to understand the expected trends and forces-of-change behind the global realities of technological advancement and the information age. The emergence of a new information age societal framework is rapidly altering the way in which social, business, economic, educational, and political exchanges are conducted. Motivating these changes is a high-tech economic equation, a technology insertion process, enabling us to "do more with less." Characteristics and dimensions of the information age environment include (1) information ecology, environment, and sociology; (2) information economy and capitalism; (3) information technology, tools, and systems; (4) information resources; (5) information conferencing and dialoguing, and (6) information politics. Without some command over the future in this high-tech information age arena, it will not be possible for Europe or any other country to remain and/or become competitive in the interconnected global economy. The European Economic Community (EEC) is falling behind in the crucial race for its economic and industrial well being, with the United States capturing over 70 percent of the world market in high-tech microcomputers, and Japan surpassing all of Europe. The emerging shift in the United States and world economy from the European countries to the Pacific Basin countries presents a myriad of new opportunities, problems, outlooks, and power shifts. Future global events should be viewed as opportunities to plan and design through the use of proactive, anticipatory management rather than as problems to react against. (LH)

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GLOBAL HIGH-TECH ECONOMY FUTURES IN THE INFORMATION AGE

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GLOBAL HIGH-TECH ECONOMY FUTURES IN THE INFORMATION AGE

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ABSTRACT

The emergence of a new information age societal framework, driven by rapid advances in the high-technology areas of computers, telecommunications, office automation, user-friendly software, and the like, is radically altering the way economic, business, social, educational, and political interchanges are conducted. This paper addresses the resulting and developing global economy for this new era and forecasts some of its direction and consequences. It presents a high-tech economy equation for fanning the forces-of-change. It further characterizes most likely futures for the information age, global dynamics of change, the emerging Pacific Age, engines-of-change, and more.

INTRODUCTION

The high-tech forces-of-change now operative and projected, portend myriad possibilities for the global economy, resulting from rapid technological advance in the information age. With technological developments accelerating, however, it becomes increasingly difficult to forecast what the future holds merely by extrapolating past growth trends. New developments spawned by new technological insertions, fierce international competition, massive application of computers, and a multitude of other high-tech forces are harbingers of newly developing trends that can be forecasted to accelerate faster and impact harder than many past trends.

As a result, a new high-tech revolution that will influence and direct the global economy must now be forecasted.

THE NEW GLOBAL HIGH-TECH ECONOMIC EQUATION

The world is in the early stages of a transformation, for the first time in human history, wherein a new age is emerging on a global scale — in which all nations are participating, albeit some ahead of and faster than others. This new global civilization now forming comes with many flavors and names. Relatively new information related technologies are driving the economic and social growth and health of nations as well as job creation -- therefore, we call it the information revolution or age. But it has many other dimensions.

Change is accelerating, forcing this global transition as new high-tech advances are rapidly inserted to enhance products, services, processes, systems, competition, profits, and the like. Its forced multifaceted dimensionality includes to varying degrees a worldwide information age, computer age, high-tech age, bio-genetic age, neo-agriculture age, neo-medical/health age, and other characteristics. This technology insertion process is also speeding-up, impacting to change globally our way of life, our jobs, our SOL and QOL, our governments, our things, our outlooks, our aspirations, and our futures.

The reason for the acceleration of high-tech forced change, which is increasingly information related, is quite simple. First, consider that we have accelerated research and development (R&D) worldwide in recent decades. Second, this R&D advances our state-of-knowledge of how to do things more efficiently and to do that which was impossible in the past. Third, the application of this new knowledge, via a technology insertion process, allows us "to do more with less"! That is, with less input of labor, energy, resources, and/or capital we achieve more output — more productivity, more performance, more alternatives, more ways to ease our lot, etc.

Thus, because of this "**more for less**" equation, there should be little wonder why a transformation is occurring now that we know how to apply this high-tech age equation.

But with this very desirable outcome of applying our new knowledge also breeds many consequences. At the leading edge of the wake of high-tech insertion the global economic and power balance equations are also restructured in international relations as the nature of war is transformed with new military technology. Jobs are displaced in one region and created in others as new technology obsoletes an older industry, product or service, and at the same time as the development of new industries occurs. The result is impacts on a global scale for jobs and the expansion of the global economy. Developed nations are forced to change to develop new industries and markets. Lesser developed nations are forced to participate in order to grab the opportunities now vividly portrayed over the new media systems they are watching. They also are forced to switch their industrial base as the old parts are no longer needed and to enter the race for a slice of the new areas in order to keep themselves economically healthy.

The consequence is a shifting geographic location of 1) jobs and 2) acquisition of resources, etc. Further, gaps close and widen more rapidly in this era of fast-paced change.

Now the development of this transition on a global scale is not an even process. Even leading nations (of the recent past) rapidly shift position, as well as lesser developed third world nations. That is, nations have new competitors. Does this imply that new friendships and new enemies are developing? By 1995, does this mean new alliances will be formed worldwide? These and many other questions promise new post-industrial/information age/high-tech age/global economy/bio-genetic politics — changing as rapidly as the global revolution that spawns them and fans the forces-of-change.

Unfortunately, the global revolution, as seen by each of us in our own microcosms, looks more like slow (but faster than the past) evolutionary change. As a result, too many of us are lulled into reactive management tactics at the micro level rather than at the needed macro/global system level -- and via developing proactive strategic management plans on a global scale.

HIGH-TECH ECONOMIC GROWTH ENGINES

Economic growth, boosted by technology innovation, poses considerable challenge for nations, states, and industry as high-tech advances rapidly alter society's

"motors of growth."

Yesterday's high-tech motors of growth for the U.S.A., and to some extent Europe, were steel; oil; chemicals; automobiles; machine tools; first-generation space age explorations; household electrical appliances; and agricultural products. Today these economic-producing engines are operating largely elsewhere (e.g., in Japan) and powering other nations' growth (automobile industry) or are in the process of being completely overhauled (steel), or they are in an increasingly vulnerable position (chemicals), or are approaching market saturation in the developed countries (household appliances).

Today's high-tech economic growth engines are computers, microelectronics, defense technology, energy, telecommunications, and related services. However, in the rapid pace of transition from an industrial-based economy to one driven by information age technology, considerable economic displacements are occurring -- displacements with which the other sectors of society are finding it difficult to keep pace. That is, the slowness of government, management, schools and political systems to jump aboard the new age creates the risk that in the years to come these new high-tech arenas will not be viably operating in Europe or the U.S.A. Already, some of these industries are starting to migrate to the third world. Japan has announced its intention to become the leader in computers, bio-tech, and telecommunications. But, the international division of the high-tech pie is not predestined. Many efforts, more than were advanced for yesterday's high-tech industry migrations, are being put forward to proactively prevent a future loss of jobs and economic displacements.

Tomorrow's motors of growth are forecastable. They are the high-tech economic producing engines of artificial intelligence, expert knowledge-based systems, supercomputers, late 4th generation microcomputers, bio-genetic technology, monoclonal antibodies, computer-designed artificial molecular DNA, bio-computers, bio-prosthesis, bio-sensors, genetically engineered medical and agricultural products, 5th generation computers, next generation computer graphics, next generation robots, next generation space technology, the emerging information utility, synthetic and computer designed chemicals and materials -- and their related secondary service economy.

But, for this new age technology, nations must subsidize considerable R&D in order to be in the running. And industry must jump on the bandwagon early on.

It is important that the high-tech strategies of change, research and innovation, technology development, and business venturing be established on a timely basis. Getting in too big, too early can be costly and disastrous. On the other hand, waiting too long to enter the fray could be equally disastrous when entrenched competition drives the prices below the start-up costs of the entering firms.

The emergence of a "new international information high-technology economic order" presupposes for any entrant some considerable technological, social, economic, political, and industrial command of support service networks to ensure the survival of its nation's industry base and its associated economy. Nations must also be prepared to participate in the design and planning of an orderly and autonomous transition, of its total society, for the new age it is growing and to find its place in an interconnected global society and economy.

Many trends are afoot to change the international alignment of industrial sectors and the future geographic locations for the acquisition of resources, manufactured products, and delivered services. In a number of traditional key sectors in Europe and the U.S.A., industry is again threatened with the prospect of being overtaken by their main, and/or new competitors. All too often in those entrenched industrial areas faced with change, management remains trapped in the priorities of the past — with misdirected policies for holding onto the glorious past. In past eras, this was America's view of Europe — now both are in the same boat, needing to update faster, to re-orient industrial policies, to develop new R&D plans, and to acknowledge rapidly changing near-future high-tech challenges.

There can no longer be any doubt that science and technology will play an enlarged role in the coming years and decades. Industrial activities contain ever-growing high-tech elements. The basic reason is simple: high-tech advances provide "more-for-less". Scientific breakthroughs can pave the way for profitable new activities in the short run, rather than requiring many years and decades of financial drain before turning profitable. As a result, industry is becoming increasingly high-tech, and science has become industrial. That is, industry is now carrying a larger load of applied research activities and increasingly performing basic research. Universities are also beefing up their applied research for industrial payoffs. The character of research in academia is turning toward the industrial arena with the goal of reaping profits from innovations resulting from research conducted in their labs.

Because of the faster pace and wider spreading impacts and the consequences of societal change created by high-tech advances, technological change is becoming more political — particularly as a result of employment and economic displacements that require governments worldwide to intervene. Most politicians are beginning to learn that reactive political action, after the negative displacements occur, come too late to solve the problems created. All too often efforts are directed to holding onto the past too long, thus failing to grab high-tech opportunities and to enter into the next era. As a result, many politicians are beginning to implement proactive political incentives -- subsidies and the like — to attract new high-tech industries and thus speeding the transition to the emerging new age. Such efforts are cooperative — involve local government, industry, academia, and labor to create regional "magnets" to attract new high-tech industries.

Technological development by itself, however, does not guarantee long-term competitiveness, and jobs. Nor does it guarantee the social well-being of industries, regions, or nations. In addition, viable and preferable futures depend on the capacity of management and government to master: 1) the understanding of the new technology; 2) the technological change to expect; and 3) the new rules to manage by — and much more. For example, the five leading job categories in the computer field grew at unprecedented rates in the 1970's — some by more than 200 percent. But they accounted for only five percent of the job growth in that decade. Computer sales, however, from an economic viewpoint, expanded even more and today represents a considerable percentage of the GNP.

We are in a technological age of rapid change. People in the 1970s were additionally scared by the energy crises and the resulting unemployment crisis

that we still experience. The first part of the 1980s has been marked by both a recession and by high-tech opportunities. The later half of the 1980s could go in many directions. One highly likely possibility is an expanded growth of opportunities emerging from high-tech industries. Another is the possibility of massive robot application. In addition and in parallel, the future in the 1980s and 1990s will of certainty be marked as the computer age -- as computers continue to penetrate on a massive scale all sectors of the economy. The 1990s will be imprinted with bio-technology and AI. That is, we could be moving from the recent era which denoted the decades with crisis labels toward an era shining with opportunities — made possible from high-tech advances.

Although high-tech "hardware" advances have become a major driving force for societal change, the "software" of our societies appears to be the beneficiary of such advance since we are learning to understand, interpret, forecast, anticipate, plan, and manage change. Increasingly, it is this adaptability of the soft side of our society which surfaces as the most important factor to manage in order to create industrial and economic strength in a high-tech age. Here and in Europe, considerable experimentation is going on to develop information-age industrial, economic, political, environmental, energy, material, and social policies to cope with high-tech forced rapid change. A case can be made that, even with our many mistakes, we are learning to create better policies as time goes on.

High-tech industry strategies differ greatly from non-high-tech industry strategies as is shown in Table 1. Accountants, managers, and consultants must take differing approaches in providing their services to the two types of industry.

TABLE 1: HIGH-TECH INDUSTRIAL STRATEGY — INFRASTRUCTURAL DIFFERENCES BETWEEN HIGH-TECH AND NON-HIGH-TECH INDUSTRY

AREA OF CONSIDERATION	IN NON-HIGH-TECH INDUSTRY	IN HIGH-TECH INDUSTRY
GROWTH	o Low/flat/negative o Diversify/retrench/consolidate o Milk/divest o Highly price-competitive o Grow market share o Slow change	o Rapid and positive o Expand/do R&D/innovate o Fund/buy/start-ups o Highly performance competitive o Grow market o Rapid change
FINANCIAL/ FISCAL	o Controls o Problems o Fewer R&D funds o Cost centers o Asset manage	o Development o Opportunities o Available venture capital o Profit centers o Revenue manage
GOVERNMENT/ REGION/SOCIETY	o Regulate/de-regulate o Bail-outs o Job displacements/loss o SOL issues	o Incentive/subsidize o Fund R&D o Job creation o QOL issues

	o Negative impacts	o Structural change
	o Economic illness	o Economic health
INDUSTRY PACS	o SOS bail-out calls	o Cooperation/ventures
	o Import duties	o Free market
	o Reactive	o Proactive
	o Protection politics	o Partnerships
	o Shut-downs/moves	o Expansion
	o Issue manage	o Venture manage

Further, computers and their marriage with communications, are increasingly giving, through global networks, democratic access to society's information — in the real-time of our need. Also, the developing trends toward artifically intelligent and expert knowledge systems, and the emerging information utility industry, the 1990 decade can be forecasted as the age of democratic access to the globe's knowledge and expertise.

INFORMATION AGE CHARACTERISTICS

Massive technological forces are building for drastically altering the set of alternative futures which will become most likely for the remainder of this century and beyond.

Rapid and accelerating advances are occurring in science and technology — especially in computers, communications, artificial intelligence, genetics, agriculture, microbiology, space and chemistry. Economic, political and social forces, which will cause step function changes, are also building.

The emergence of a new information-age societal framework, based upon the expanded use of and the need for information, supplied by electronic computers and communications, is altering the way in which social, business, economic, education, and political exchanges are conducted. Information-age technology is thundering in on most jobs and into many homes. Information-age technology alters the way knowledge is created, stored, retrieved, and applied; the character and type of jobs we work at; the ways people are linked; and the infrastructure of society. These will, in turn, impact and change the tools we use in the information age. This is a revolution for society. In the architecture, organization, processing, and dissemination of information/knowledge, future computers will perform a central role and will speed the societal transformation underway.

To get a handle on what futures we are growing, we must first understand the information-age environment. Its many characteristics and dimensions include:

Information Ecology, Environment & Sociology
Information Economy and Capitalism
Information Technology, Tools & Systems
Information Resources
Information Conferencing and Dialoguing
Information Politics.

Information ecology includes a new-age sociology of many dimensions: information

interactions, real-time knowledge access and amplification, information/knowledge engineering, information management and politics, new job creation and job displacements, and new individual freedoms, and new protection options and impacts. In an information age, an information economy transforms capitalism in many forms. Information becomes a basic need and the major social capital and societal power source. In an information economy, information substitutes knowledge for capital, energy, jobs, materials, and travel. It de-industrializes jobs by substituting information flows to automated tools and robots for performing work. An information age radically alters societal roles, values, jobs, and needs by redesigning the economy and society via advanced technology.

Information technology marries computers and communications into many other things and, in the process, makes "things" smart and intelligent. Part of this information technology tool kit consists of: people-amplifying appliances (computers, calculators, expert systems, etc.), micro-technology/computers/communications, information appliances (e.g., word processors, "paperless book" systems, computer mail systems, etc.), information systems, information networks, information utilities, information software (DBM/MIS/DSS/OA/CAD/CAM/MRP/KIP/ ...), computer integrated manufacturing, data bases and information services. Information technology is part of the information resource environment, which includes a rapidly expanding information industry, laws, controls, standards, knowledge bases, media, telecommunication and data communication systems, and computer-aided systems (e.g., CAD, CAI, CAM, etc.).

In this new information age, people increasingly "discourse" and "dialog" directly with information via computer terminals, teleconferencing, computer-conferencing, and the like, instead of just with people. Information conferencing allows us to conquer distance via electronic computer/communication networks with information appliances backed-up with information services, data bases, knowledge bases and information retrieval and information management software systems. In such an information environment, policy making, management decision making, people-to-people, people-to-machine, and machine-to-machine interacting, and machine operation increasingly are performed remotely via computer networks using screens, voice channels, keyboards, and data bases, instead of in face-to-face interactions in conference rooms, back-rooms, offices, or factories.

Information politics includes individual privacy and freedom considerations relative to "data-basing people, jobs and employment," societal power structure changes, transborder data flows, information taxing, and the like.

In the process, the information economy now growing increasingly moves a major portion of the GNP from being supplied by the sale of products to being supplied by sales of information services; i.e., sales of information, information systems, information networking, and information assistance.

Taken in total such a future information environment, now birthing, points to a long list of new information related new computer applications -- many of which have their precursors in the primitive data base management systems, management information systems, decision support systems, and computer-aided-design/instruction systems now in place. For the computer world, and this neo-modern information age, into which we are leaping, evolutionary

advance is the name of the game, rather than revolution — even though for society it is revolutionary relative to the magnitude of change occurring and to the impacts expected and forecastable, and that we are now experiencing.

For example, the current computer revolution differs in several critical aspects from the early 1950's when computers and automation were introduced. First, computer applications are changing from: 1) large, centralized, and costly computer hardware and software to distributed, personal, and low-cost systems, 2) use of computers by a few large firms (e.g., the military, large businesses, and the Federal government) to use by individuals at work and at home and being embedded in a wide variety of machines, 3) displacing "low-level" jobs to displacing "high-level" jobs, 4) creating more jobs than are displaced toward the real possibility of displacing jobs faster than society can create new ones, 5) automating industrial-age systems to automating post-industrial information-age systems and jobs, and 6) computer systems that required considerable education and software development in order to apply them to easy-to-use systems with a vast array of ready-to-use packaged software.

The major change occurring is that total computer system and usage costs are diving ever faster, while, at the same time, their functionality, capability, and applicability are increasing. Computers have passed the threshold of affordability by individuals and are entering an era of being involved in our daily lives — and are being massively employed. And these trends can be expected to accelerate.

HIGH-TECH EUROPE

Europe, in its information age beginnings, is faced with a host of myths, threats and opportunities. The multiple transition of Europe into 1) an information society, 2) a high-tech age, 3) the computer age, and 4) a bio-society is challenging for both industry and government. It is requiring a synthesis and integration of new age parameters with entrenched traditions. Europe is far from some form of unity of direction — even the EEC creates differences amongst its members -- with each country being unique in its purpose and stage of industrialization.

The first industrial revolution was spawned in the mid-18th century in Europe (the U.K.) and was fueled by coal to generate steam in Britain. The second industrial revolution emerged about 1900, getting its push from technological developments in the chemical and electrical industries largely in Germany -- again in Europe. The current and third industrial revolution now under way is propelled by electronics — the information age high-technology of microchips. This time, however, the driving force geographic locus has moved from Europe to the U.S. and Japan — leaving western Europe far behind.

Information has become a basic economic, cultural, individual, social and industrial activity. In the U.S., about two thirds of the work force is engaged in the information sector, whereas in western Europe it is one third. Information usage and tasks depend greatly upon the technology. Thus, major changes and advances in high-technology have considerable economic and social impacts and implications of sizeable downstream (in time) consequences on industry and society.

However, rapid development in technology does not, by itself, ensure or result in equally rapid changes in the infrastructure of society. Other factors including deeply rooted cultural habits and values, labor-management agreements, economic and social policy, education change and/or policy, and especially the political environment are also major determinants of societal change and development. When pervasive high-technology, like computers and our expectations for bio-genetic technology, hit the scene, cutting across all areas of society with rapidly advancing amplifications, opportunities and displacements, the society is radically altered by societal reactions to the tech impacts.

Although it may be obvious, it still pays to re-emphasize that the question for Europeans faced with high-tech is no longer a choice between acceptance and rejection. High-tech has become unavoidable for Europe, because:

- Europeans want, and thus need, the benefits, products and services provided by high-tech
- High-tech can be used to combat important long standing societal problems — e.g., job creation
- Industry needs high-tech for international competitiveness reasons — e.g., for survival
- High-tech (like computers) is replacing old line industries and ways of doing things because it is more efficient and productive
- Europe hasn't discovered alternatives to high-tech.

Without some command over their future, in the high-tech arena, it will not be possible for Europe, or for that matter any country, to remain, and/or become, competitive in the interconnected global economy now existing. That is, to be competitive for the future requires a high-tech industrial basis for the information age. The current scene for Europe in computers, bio-technology, semiconductors and many other key high-tech areas vividly shows discouragingly that Europe does not possess this command. Thus, there is a real risk that Europe could miss in its attempts to jump aboard the fast moving high-tech train — especially since it is traditionally slow to react with needed venture capital, policies, etc.

If so, what would Europe's future trading stock become? One answer could be ideas and research results since Europe has excellent universities. Another could be information services that the U.S.A. is ill-equipped to deliver. One possibility could be information services requiring bi-lingual data — e.g., data bases, knowledge bases, teletext, etc. But, will these be enough?

Among the EEC countries there are major differences in their capacity for high-tech innovation and production, institutional means and infrastructures for change, technology and industry diffusion patterns, and strategies/policies for change and high-tech. The technological European leaders like the U.K., France, Germany and Sweden are likely to continue their trend toward further specialization within the international division of industry and labor. Greece, Spain and Portugal are examples of EEC countries which currently lack the means

to develop rapidly advanced high-tech — as a result, the gaps most likely will widen for them as they become low cost labor pools.

However, even though the command of information is a critical future element of a nation's autonomy and of its strength in the global economoy, such command can be achieved from two aspects:

0 An industrial infrastructure for producing high-technology, or

0 Access to and the use of high-tech.

But to be just a user of high-tech, supplied by other nations, requires that such a nation finds other engines of economic growth niches. Since the traditional industrial arenas are shifting, and largely headed downhill economically for Europe, this is no small order — and as yet this challenge has not been mounted.

The EEC has started funding its cooperative effort, ESPRIT, to position Europe for the high-tech area of information technology. It is expected to be funded to the level of 1.3 billion dollars to advance the state-of-the-art and industrialization of:

0 Advanced microelectronics
0 Advanced information processing — including 5th generation computers
0 Office automation
0 Software technology
0 Computer-integrated flexible manufacturing — and more

The EEC recognizes that no European country can cover the spread of high-tech opportunity options without government policies and help — and cooperation. But, its feeble attempt in ESPRIT falls considerably short of plans and efforts in the U.S.A. and Japan. Nevertheless, ESPRIT is big enough to bear some fruit. It will and is being watered down through funding many small efforts in many countries and companies — it even appears that IBM-Europe will get a chunk!

Thus again, jumping into the high-tech arena will not guarantee leading Europe out of its crisis nor position it for the new age. Moving into high-tech also must be accompanied by creative industrial and social policies and innovations — which appear as yet not to be forthcoming. However, the U.S.A. and even Japan are also more or less floundering in this critical area — but not to the extent of the Europeans.

However, we can be sure that new relationships between society, industry, government and technology are being established as older entrenched areas are being eroded.

For the long term, the motor for growth seems to be generally agreed upon by the U.S.A. and Europe to be the service sector. Should this forecast turn out to be a reality, then this trend poses tremendous challenges to Europe. Already the signs of an international division of high-tech business are clear. Europe is already using computers, knowledge, software, satellite communications services and research results of major origin outside of Europe to fuel its new age. Preparing and jockeying for a position in this internationalization of high-tech services

is thus already posing the challenge to Europe to be in a catch-up position.

If Europe will not be a major factor for either supplying high-tech products or services, then what will be Europe's role for the future in the 1980's and 90's? At the present, answering this question is the major challenge facing European industry — another answer appears to be spotty specialized areas.

Advancing high-technology widens the options, but poses the challenge of change and finding one's place in the transitioning society for the new age being developed. To do so, a long term high-tech strategy must be formulated — as yet this challenge has not been met either.

The scene is not, however, all gloom and doom for Europe. There are many areas where advances are being made on the high-tech front -- but the picture is spotty.

For the world beyond the U.S.A., western Europe and Japan, the scene is even more "iffy" and spotty for the high-tech age.

Thus, the high-tech gap is widening. In 1978 western Europe had a half billion dollar surplus in high-technology exports like robots, digital telecommunications systems, computers, computer controlled industrial machines, and machine tools. In 1980 the export surplus evaporated in high-tech moving to a five billion dollar shortfall. By 1982, the high-tech trade deficit had doubled to ten billion dollars — with U.S. and Japanese exports to western Europe still growing.

In the information age crucial high-tech field of microcomputers, the industry upon which much of the new revolution is based, the Europeans have captured less than 10% of the world market, whereas, the U.S. has over 70% and Japan surpasses all of Europe.

Today, the European continent is flooded with IBM computers, Matsushita video tape recorders and Boeing jet liners. However, here and there European innovations, armed with home grown research and breakthrough discoveries, and new marketing savvy are elbowing into lucrative high-tech fields. These modest inroads are the bright side of the painful high-tech reality scene. Western Europe has been caught unprepared for the accelerating high-technology revolution brewing beyond its shores.

There are the bright side exceptions in Europe. Many European nations are world leaders in certain industrial arenas; West Germany leads in machine tools and engine technology, Britain in precision instruments, Switzerland in pharmaceuticals, Sweden in robots and to some extent Britain, Germany, Austria and Sweden in high-tech research breakthroughs. In the main, western Europe thus remains close to the U.S. and ahead of Japan in a number of high-tech fields of scientific achievement. But, Europe has been unable in most cases to turn laboratory research into commercial products -- where the U.S. and Japan are clearly the masters.

The obstacles to high-technology progress are formidable in Europe — tradition, old roadblocks, and rivalries put brakes on Europe's attempts to move into the high-tech industrial age. As a result, Europe is falling behind in the crucial

race for its future economic and industrial well-being. Despite the unifying efforts of the European Economic Community (EEC), nationalism thrives and gets in the way of change and waters down limited resources — fragmenting their markets, isolating them inside political boundaries, and the like. As a result, even the giants such as The Netherlands' Philips (telecommunications and semiconductors), Italy's Olivetti (office machines) and West Germany's Siemans (computers) lack access to large enough "home" (EEC) markets to build the needed economy of scale to:

0 Justify the cost of independent high-tech research and product development

0 Compete in international markets — without huge subsidies.

Trade within the ten EEC nations has been further stifled by a thicket of barriers — preferential governmental buying, differing designs and standards equalling more than a 10% tariff, ...

The simple fact of the matter is that high-tech industries are the engines of growth for jobs of the future -- contrary to considerable contemporary literature, which has overlooked the secondary level of job creation; for every 100 new high-tech jobs, about 70 are also created in classical industry and services. This fact alone explains why the top 10 occupations with the largest expected job growth are clerical and lower level service type jobs.

The economic engines of growth for the high-tech era come from multiple avenues. For example, in less than a decade the North Sea has made Britain the world's fifth largest oil producer — oil now accounts for five percent of its GNP. Other western European national economies have also been transformed by North Sea oil -- especially Norway. Currently, the oil economy roller coaster is in one of its downturn dips, but forecasts indicate the movement to an upswing, thus pointing toward a brighter economic future for parts of Europe.

The worldwide craving for chips -- the high-tech micro-engines for computers, video games, cameras, televisions, household appliances, and autos -- is forecasted to grow as much as 40% per year well into the decade of the 1990's. However, the best bet for investors might very well not be the chip makers, but rather the companies producing the machines to make the chips, chip integration levels are advancing at a rate that approximately doubles the amount of circuitry on a chip every year. To keep up such rapid paced silicon micro-chip development, demands a switching (advancing) of chip making technology about every three years.

The U.S.A. semiconductor production equipment companies — Applied Materials, Inc., Silicon Valley Group, Varian Associates, and GCA Corp. -- dominate the world market for chip-making machines. As yet, there are no Japanese, European and U.S.A. firms that threaten these four companies. Semiconductor production equipment moved from a world market of one billion dollars in 1980 to four billion in 1984 — and is forecasted to reach twelve billion dollars before 1990. Its advance has been a steady growth and expected to be on a smooth upward curve — unlike the dips and blips in chip sales.

Here again is an example of Europe's shying away from the leading edge high-tech

arena — even though it excels in the traditional machine tool market arena.

Growth prospects for most of the less developed countries continue to deterioriate with little expectation for moving rapidly into high-tech — except for the high-tech industries to manufacture products on their soils to reap benefits of low cost labor and underdeveloped mineral and ore resources.

From a number of viewpoints, India, Brazil and Mexico are exceptions. India, for example, has in recent years tripled its food production, began the process for approaching energy self-sufficiency and greatly increased its domestic manufacturing. Brazil continues its push to be the key industrial supplier of manufactured goods for the 3rd world nations and the "OPEC of alcohol" to the world. But Brazil has real economic problems. Mexico's economy is in a turn-around, as is its industrial might, both now on new paths.

Proportionately, India is slightly less dependent on imports than is the U.S. In 1950, India's installed electrical generating capacity was 2,300 megawatts, by 1983 they achieved more than a 15 fold increase to 38,000 megawatts! — another example of India's push toward industrialization. Further, India is well-endowed with raw materials — mostly underdeveloped. Thus, trends in India and Mexico are favorable — but for most of the third world the trends are downhill.

The fast pace of high-technology industries means that managers and politicians alike need to be cooperatively literate in dealing with more than micro- and macro-economic variables, but also with the nitty-gritty guts of the advancing high-technology.

Their management of high-tech is less of a financial-economic phenomenon than of science and technology — but both high-tech financial and technology literacy are critical. The crux of the problem is high-tech expectations. In recent decades industrial management increasingly pushed technological decisions down to lower and lower levels — down to the engineers. As a result, managers worldwide are caught short without high-tech literacy. The Japanese early-on recognized this failing of western managers and took steps to correct it in their ranks — their success is legend.

Expectations drive the high-tech markets. The market doesn't like surprises. Thus, high-tech managers also need to be increasingly literate of evolutionary and breakthrough developments, trends, and forecasts.

PACIFIC AGE

The United States is in the midst of innumerable transitions. Their diverse nature for the 1980s includes characteristics for focusing our economy for such multifaceted areas as a computer age, an information age, a high-tech age, a space age, a global society, the entrepreneural decade, the Reagonomics era, and the like. In the last few years the United States has entered yet another age -- the Pacific Age. Since 1978 more trade has been occurring with the Pacific countries than with Europe. That is, more trade has been occurring, and is projected to continue to occur, across the Pacific Ocean than the Atlantic.

Thus, after approximately 350 years, the Atlantic Age has been replaced by the Pacific Age for the U.S.A. — and for the world. Now in the 1980s, the Pacific Basin Club of Nations -- such as Australia, Canada, Central and South America, China, Hong Kong, Indonesia, Japan, Malaysia, Mexico, New Zealand, the Philippines, Singapore, Korea, Taiwan, Thailand, the United States — consists of more than half of the world's population and controls more than 60 percent of the world's gross national product. The Pacific Club members, excluding the U.S., now equal two-thirds of the U.S. GNP.

This fundamental shift in the U.S. and world's economic and political power from the Atlantic, including Europe, to the Pacific Club presents a myriad of new opportunities, problems, possibilities, challenges, outlooks, and power shifts — that is, change.

The Pacific Age means on the one hand:

- o A switch in our economic thinking — toward a new set of economic allies
- o New growth markets
- o The need for understanding and education relative to the Pacific Club nations
- o New policies and incentives for encouraging Pacific Club interactions
- o Development of new friendships with heretofore largely unknown or misunderstood Pacific Club members;

and on the other hand recognition of the:

- o Economic growth and tougher competition by the other Pacific Club members
- o Widening gap of the need for our understanding of the Pacific Club nations' trends, values, cultures, and the like and the reality that most of us are illiterate in these areas
- o Awakening to the outmoded U.S. economic policy responses to the Pacific Club nations and the need for change.

Thus, the future of the U.S. in the Pacific Age requires many things and presents new challenges — which if properly planned and met would/could create a more desirable and appropriate future for both the Pacific and Atlantic Club nations. Certainly we need to cooperate more with these new Pacific economic partners as well as with our older ones.

With our Pacific Club neighbors, we are in the early stages of an evolutionary trend process, of revolutionary potential, which will totally alter the infrastructure of the world. The dynamism and growth in the Pacific Club are

building world economic and political strength which will increasingly control the direction that the world will follow.

Isn't it time to make it "mandatory" for students and adults alike to learn about the Pacific Club nations and their economic, social, political, and cultural dynamics of change? At the minimum, each of us should be reading "classics" from the Pacific Club regions — rather than just European and U.S. classics.

AN ECONOMIC PARADIGM CHANGE

In leaving the industrial age culture and entering the new socio-techical information age in the post-industrial era, society is transformed from the machine age into a high-tech information era. Its economy is transformed to one of global dimensions. The foundations of the industrial/machine age consisted basically of the sciences of reductionalism which are backward looking and gave rise to the analytical way of thinking for discovering and seeking understanding of the nature of the world. In this age of analysis, the basic ideas were decomposition (dividing things into parts) of past experience, problem-solution sciences, and thus reactive decision-making, technology and management ethics, cause-effect relationships, the deterministic world approach, closed system schemes, and mechanistic outlooks which lead to the disciplinary approach to science.

Mute testimony to this machine age now resides in universities, laws, and public school curriculums as well as in science museums. The end product of this mechanization resulted in automation, in particular the automating away of production-oriented work, which ushered in the new age of the post-industrial service era of the Information Age economy.

The new intellectual framework the information age, now developing to replace the mechanistic and reductionist doctrines, and the analytical modes of thought, is one supplemented with the doctrines of teleology, systems, synthesis, and the forward looking anticipatory sciences. These concepts include the frameworks of choice (alternatives), purpose (goals), cybernetics, functional systems, feedbacks, impacts, consequences, synergism, symbiotics, dynamical systems, evolutionary synthesis, and more.

Its primary mode of thinking tends toward the fusion of the sciences, arts and humanities into holistic systems rather than separate and isolated machines. It becomes basically multidisciplinary, interdisciplinary, and transdisciplinary. That is, the effective study of the future, large-scale social systems, world models, and the like, together with politics, economics, business, government, design and management, now requires synthesis throughout the sciences, arts, engineering, humanities, and technology in order to organize them into a total system of thought. Laws must also be forecasted to be radically altered to meet the needs of such a drastically different age. The new age developing requires general systems sciences type thinking as a new basis for management -- and requires that management develop general systems inquiring competencies.

Further, because of rapid change due to a speed-up of technology insertion, society and its economic system must become more anticipatory in nature.

CONCLUSION

The global economy now developing for the future, steered by high-tech advances and insertion, presents many new challenges. If we become more anticipatory, using a proactive anticipatory management philosophy, then future global events can be viewed as an opportunity scape to plan and design rather than a problematique to react against.

High-tech and the information society are global economic realities that are of growing importance to society. To understand their expected trends and force-of-change has become a necessary precursor to understanding the developing global economy and future that they are forcing.